The Engineering News.

A Journal of Practical Science and Public Improvements.

PUBLISHED MONTHLY.

JUNE 15th, 1875.

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Public Works of Chicago.

[CONCLUDED.]

THE SEWERS.

The *drainage of cellars has been considered.* When their bottoms are not too low, they could be drained into the proposed sewers, provided the precautions against being flooded by excessive storm-water already mentioned, should be used. This, in most localities, would allow of a cellar six feet deep, if the first floor was placed two feet above the sidewalk. Deeper cellars could not be provided for, without pumping up the contents of the sewers, or raising the grades of the street higher. Were a system of sewers designed with especial reference to the drainage of such cellars as are now desired, it is by no means certain that it would be sufficient to meet the demands of a few years hence. The *sewers of New York and Boston* have generally been laid with reference to what was supposed to be, when they were made, ample cellar drainage, but already there are to be found in both cities, "two story cellars," which cannot be drained into the common sewers,

The main object of the sewerage law is to provide for the healthfulness of the city; deep cellars though of great value already, in some parts of it, and very convenient in others, are not essential to health, but probably diminish rather than increase it. The fact, however, that the drainage of deep cellars may not be provided for at the public expense, need not prevent the owners of them from joining together and draining them, at an annual cost of less than ten dollars for each twenty feet front.

Perhaps this may be the most proper place to say a few words with reference to a system of drainage strongly recommended by some, because of its success on a small scale, in certain localities. The system is that of SUBMERGED SEWERS EMPTYING INTO THE LAKE OR RIVER The supposed advantage being, that the substances admitted into the sewers, would be kept constantly in a fluid state, would not emit such offensive odors, and would be easily driven out by a head of water. It is very evident, however, that the mere fact of a sewer being submerged, would not increase its capacity for discharging, and that if it were long with but a slight head available for flushing, it would be impossible to create a current sufficiently strong to cleanse it. In that case it must sooner or later fill up. Such sewers have been laid again and again in London and Paris, and other cities, and have received universal condemnation, except for short lines with an affective available head. When such sewers become filled up, they are often abandoned, in consequence not only of the expense and danger to life from cleansing them, but of the intolerable nuisance such an operation would create.

The different communications, thirty-nine in number, that have been received by the Commissioners, proposing plans for draining this city, have been examined. Some of them are very able and interesting papers, and though not followed in the system now recommended, they have been very valuable in pointing out matters of great local importance. In conclusion, it will be stated, that while very able and competent engineers differ essentially in their views as to the best mode of draining such cities as Chicago, it would not be safe to rely merely upon numerical estimates of costs of construction or maintenance solely in deciding such a question.

After the consideration of all estimates that can be based upon reliable data, important points still remain to be decided by judgment, and cannot be reached by mere computation, As the opinions of well informed men have ever differed on important subjects, it is not to be expected, that they will be unanimous on this.

After weighing carefully all the arguments for and against different plans of draining any locality, the only course is to decide upon that which promises to combine as many advantages, with a few disadvantages, as possible.

With this view of the subject, it is believed, that the plan herein recommended should be adopted, and for the following reasons:

First. The first cost of construction would be as little as by any other mode equally efficient.

Second. The cost of maintenance would be as little as by any other equally efficient plan. The apparent complication of the system of flushing, is really no greater than should be provided for in other plans, though not required for use so often. The necessity of a regular and periodic attention to the matter, would insure greater exemption from offensive gasses, than a less frequent and more irregular system, or something nearer what is termed a self-acting one. As to a really self-acting system, requiring no attention or supervision, it is nowhere to be found in artificial drainage of cities, any more than in other branches of art, necessary for the ordinary wants or comforts of life.

Third. The healthfulness of the city would at once be greatly benefitted, by removing from the surface all stagnant water, if, at the same time, a vigilant police should prevent animal and vegetable substances from being exposed to decay in the streets or lots.

Fourth. The liability to serious interruption would be less than on any other plan; and if repairs should be needed, they could be more easily made. The importance of having every part of so extensive a system easy of access, in case repairs should be needed, can hardly be overestimated.

Fifth. Emptying the sewage through the river would carry it further out into the lake, and consequently place it more beyond the reach of being offensive than any other plan, except that of transporting it to the country, to be used as manure.

Sixth. Clean water constantly poured in the river and main sewers, in sufficient quantities, would be the best deodorizer and absorbent of noxious gases it would be practicable to obtain.

Seventh. No uncertain sources of supply, or irregular modes of action would be depended upon for purifying the river or flushing the sewers; and no useless expense would be incurred, by requiring the city water works to pump more than ten times the necessary height, admitting that they were capable of supolying such quantities as would be requisite. This would be impossible, if at the same time the demands upon them for domestic and manufacturing purposes should be met.

Eighth. The system is capable of being extended in every direction, as the growth of the city may demand it, while each sewer built would be capable of "beneficial use, independent of the further extension,," as required by section eighth of the Sewerage law.

Ninth. The deficient inclinations of sewers is compensated for by introducing a constant stream into the mains, and by means of flushing the branches; especially if the latter should be wholly or partly glazed.

The means of introducing a stream of fresh water into not only every main, but almost every branch throughout its length, are exceedingly available in Chicago. The low and flat site of the city, so unfavorable with regard to giving to the sewers the most desirable inclination, is of the greatest advantage in affording a remedy for the evils of such defficiency.

For the most reliable informations concerning fluctuations on the surface of the lake, we are indebted to Messrs. Gooding and Guthrie of the Illinois & Michigan Canal, Col. G. D. Graham. U. S. Army, and I. A. Lapham, Esq., of Milwaukee. Messrs. Wm. H. Clarke, and John Reid, Civil Engineers, and Wm. Gamble, Clerk of the Board, have rendered valuable and satisfactory assistance, in the different labors necessary for the preparation of the report and plan.

Respectfully submitted,

E. S. CHESBROUGH,

Chief Eng. of the Board of Sewerage Commission'rs.

To the Sewerage Commissioners
of the City of Chicago.

Whoever wishes to get the latest and most valuable and interesting information respecting the Iron and Steel manufacturing interests of this country, should take the *American Manufacturer and Iron World*, published weekly at Pittsburgh, Penn., by the National Iron and Steel Publishing Co.

Astronomical Notes.

PREPARED FOR THE ENGINEERING NEWS BY S. W. BURNHAM, F. R. A. S.

A brief paper in the "American Journal of Science," for June, communicates the re-discovery of one of Sir John Herschel's double stars which has been lost for nearly a century. Struve intended to include in his great work all of Herschel's pairs where the distance fell within 32″, and with few exceptions, has done so. This pair, however, was missed by him, and has not been noted, or even mentioned, by any modern observer. Herschel measured the angle in 1785, and if that result was correct, there has been a retrograde motion of about 15° since that time. He made no observations for distance, simply designating it as Class I. The two stars are now about 1″.2 apart. This pair should be watched, as physical connection is at least probable.

At the May meeting of the Royal Astronomical Society, a paper by Prof. Piazzi Smyth was read, calling attention to a remarkable change in the proper motion of a small star in Cetus, which seemed to to imply motion in an orbit as in the case of Sirius and Paragon. The variable motion was confirmed by reference to the Greenwich observations by Mr. Dunkin. An examination of the star with a large aperture would possibly lead to the discovery of the disturbing companion. The *Monthly Notices* containing the paper has not yet come to hand, and the reports of the meeting in the scientific periodicals do not give the place of the star, or its magnitude. It may possibly be known or suspected to have a companion already.

Dr. Doberck has recently published a new discussion of the period of the well-known binary star, 6 Coronae Borealis. Taking all the measures down to 1872, he finds the periodic time to be 843 years. This is considerably greater than found by previous mathematicians. The different results are so very discordant, that it is evident micrometrical work, on this, as on most of the other binary pairs, is vastly more important and necessary than computations of any kind Jacob gave the period as 195,12 years; Powell, 240 years; Klinkerfues, 420.24 years; Madler, 601.45; and Hind, 735.88. This pair is now a very easy object, and can be observed with a small aperture. Dembowski's measures in 1873, made the distance 3″.12.

The new dome of the Dearborn Observatory is substantially completed, and it only remains now to put the great equatorial in perfect adjustment, which will be done by one of the makers, Messrs Alvan Clark & Sons, who will come here during the present month, for that purpose. This dome is of the cylindrical, or turret form, and revolves upon a system of free cast iron wheels joined together by a band of wrought iron, but not connected with the dome or the wall under it. The vertical shutter is made of three sections of ordinary weighted sash, each moving in an independent groove, so all can be placed at any and the same elevation, leaving the other two-thirds of the space clear for observations. The horizontal shutter is made double, each half opening upwards, and when closed forming a tight joint in the middle. There can be no question but that the instrument and the observatory will be in much better condition for real work they have ever

been before, and it is to be hoped one of the largest telescopes in the work will no longer be allowed to stand idle, when astronomers everywhere are accomplishing so much in all the various departments.

Dr. Konkoly has examined the spectrum of a large number of meteors during the last two years, and established the presence of the lines of sodium, magnesium, carbon, strontium, and possibly lithium, in the train; while the nucleus, always gave a continuous spectrum, yellow, green, or red predominating, according to the color, blue being very rare, and violet never seen. His observations also show the interesting fact that red meteors move with extraordinary velocity.

Mr. Samuel H. Mead, Jr., of New York, was accidently killed a few weeks since, while conducting some experiments with firearms and explosive projectiles. He was widely known as the inventor of the Mead-Meigs explosive bullet, an improvement which will be generally used in the more dangerous kind of sporting, as a small ball of this pattern is far more destructive than several times its weight of lead in the usual form. The improvement is applied to all of the different calibres, and copper cartridges complete, or the bullets separately can now be had of all sizes from the smallest pocket pistol, to the heaviest military rifle. Mr. Mead was a skillful and scientific mechanic, with more than common originality; and had been a frequent contributor to the scientific periodicals. He was also known as an amateur astronomer, and took a deep interest in the practical department of the science. His death will be sincerely regreted, not only by a large number of personal friends, but by many to whom he was known by reputation all over the country.

Mr. J. M. Wilson, of Rugby, in a recent paper has discussed all the observations of the well-known double star, 61 Cygni, and arrives at the conclusion that while the measures of the present century can be represented by uniform motion in a straight line, this hypothesis will not satisfy three earlier observations, the relative path appearing to consist of two straight lines inclined about 5° to each other. He considers it unsafe to draw any conclusion at present as to physical connection between the stars, the motion being so nearly uniform and in a straight line, that no curvature can be established with certainty.

CORRESPONDENCE.

JOLIET, ILL., May 27, 1875.

EDITOR ENGINEERING NEWS.

Dear Sir:—Nothwithstanding the intimation in the May number of the NEWS that the subject of the subdivision of fractional sections has had its full share of attention, I address you upon that much discussed topic.

I find an act of Congress of April 24th, 1820, entitled "An act making further provision for the sale of public lands." One clause of this act reads as follows: "And fractional sections containing 160 acres, or upwards shall in like manner, as nearly as practicable, be subdivided into half quarter sections under such *rules and regulations as may be prescribed by the Secretary of the Treasury*." The following is a copy of the regulations issued by the Secretary of the Treasury under that law.

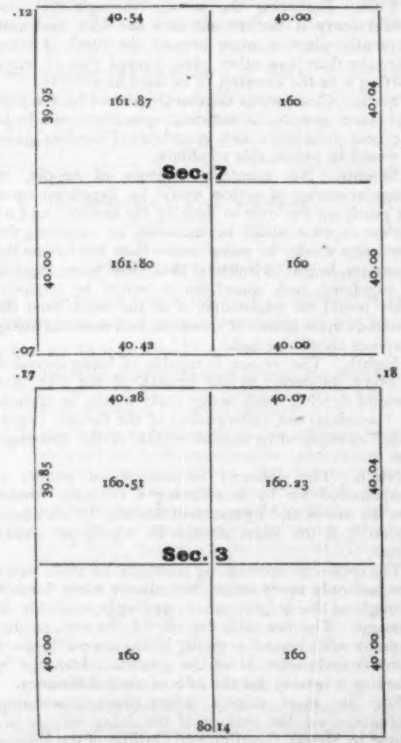
CIRCULAR TO SURVEYORS GENERAL.

JUNE 10th, 1820.

"Sirs.—In pursuance of the Act of April 24, 1820, "entitled "An Act making further provisions for the "sale of the public lands," the Secretary of the "Treasury directs that fractional sections containing "more than 160 acres shall be divided into half "quarter sections, by north and south, or east "and west lines, so as to preserve the most com- "pact and convenient forms. You will therefore be "pleased to divide the fractional sections in your dis- "trict (which remain unsold), in the manner above "directed, and report to this office, and to the regis- "ters of the land districts in which those fractions "respectively are situate, the said divisions, together "with the quantity contained in each subdivision.

"It is not intended to run the subdivisional lines, "and mark them, but merely to make them upon "your surveys, and calculate the quantity of land in "subdivsion."

Upon making an examination of the government plats to see in what manner the surveyor general executed the trusts confided to him, I find that in the north tier of sections in a township, the half section lines are established parallel to the east line of the section on which it is situated. In the west tier of sections the half section line is established parallel to the south line of the section. I refer to plats of two sections in T, 33. N. R. 13, E. of 3d P. M., in this county, with distances as shown on the government plats.



The government plats made pursuant to rules and regulations established under the foregoing law governs the actual marking of the lines upon the ground. The quarter section corner on the north line of section three aforesaid should be 40.07 chs. west of the north east corner of the section, if the section holds out the exact width shown on the plat, but if the width overruns or falls short, the difference should be divided between the two halves of the section. From the corner so established, a straight line should be run to the quarter section corner on the south line of the section. The east and west half section line is a straight line from the east to the west quarter section corner. The quarter section corner on the west line of section seven should be established in a similar manner, and this rule applies to all fractional sections upon the north and west sides of townships.

The class of fractional sections bordering upon Indian boundary lines and navigable streams, where no opposite corresponding corner can be established, only remains to be considered. This question has been pretty fully discussed in the NEWS, some claiming that the provisions of the law of Feb. 11th, 1805, requiring due east and west, or north and south lines be run from the established corners, should be observed strictly, and others still claiming that these words should be construed to mean lines parallel to the adjacent section lines. I am confident that the courts will interpret the law in favor of the latter class of claimants.

I will refer to two cases where it wuuld be impracticable to construe the law in any other way.

The act of Congress of Feb. 22d, 1817, provides that on and after the first day of September next, the sections designated by the numbers 2, 5, 20, 23, 30, and 33, in each and every township of the public lands, the sale of which is now, or hereafter may be authorized by law, shall be offered for sale either in quarter or half quarter sections, at the option of the purchaser; and in every case of the division of a quarter section, the partition shall be made by a line running due north and south. The Act of April 25th, 1820, also provides, that lands may be purchased either in entire sections, half sections, quarter sections, or half quarter sections, and in every case of the division of a quarter section, the line for the division thereof shall run north and south.

The section lines in this vicinity run about N. 1° 30′ W. I do not think that any one would contend that the words north and south in the aforesaid acts can possibly be construed to mean a due north and south course in this locality. It would be too great an absurdity to be entertained for a moment.

These words being the same as those used in the law of Feb. 11th, 1805, and being laws upon the same subject, it would certainly be held that they were intended to convey the same meaning. For these reasons and also for others that have been so ably presented in the NEWS, I am confident that the words north and south, or east or west, as used in the before mentioned laws, do mean courses parallel to the adjacent section lines. Very respectfully,

A. C., C. E.

TIPTON, IND., May 15, 1875.

MR. EDITOR.

I wish to say something more in defense of the equal area theory. In my first article, I stated that it was the intention of legislators that their laws should be founded on justice. To prove that, I will quote a few words from Blackstone. He says, "Municipal or civil law is the rule of civil conduct prescribed by the supreme power in the state, commanding what is right, and prohibiting what is wrong." I admit that this definition is not strictly true in every particular, for the supreme power does not always command what is right, nor prohibit everything which is wrong. But the commands which *are* made, are intended to be right, and the prohibitions are thought to be wrong.

Congress is the supreme power in the United States, and in enacting the law of February 11th, 1805, according to the author quoted, it commanded what was right, or intended to be, and prohibited what was wrong. It commanded equidistant corners, which was right; it prohibited surveyors from locating the center corner of a section without running through it. It also prohibited zig-zag lines, thereby making many corners to the same tract of land Both of which have been practiced, and in my opinion Congress intended to prohibit both, by commanding surveyors to run straight lines to the opposite corresponding corners. But it seems unreasonable to suppose that Congress would have ordered an exact straight line through the section, if it had known how crooked the exterior lines were. The supposition was, that section lines were nearly straight; hence the command is to make our surveys agree with the original—in *corners*, *lines*, and *areas*. Does it look like making our surveys agree with the original, if we make exact straight interior lines, while the exterior are so crooked? But if we place the corners equidistant, as the law demands, our work then agrees with the original. The interior lines will have an intermediate bearing, just as the law says, in certain fractional sections "run due north and south." which means, as I think, intermediate bearings. But

why command certain fractional sections to be run with intermediate bearings, and whole sections by a different bearing? Surely that must be a wrong construction of the law.

Any one at all acquainted with the shape of sections as they came from the hands of the original surveyors, knows that the intersection of *straight* cross lines, would not one time in twenty, do justice to the land owners; hence, would not be right; and according to the author referred to, prohibited by commanding equidistant corners. Suppose that J. M., or any one of the straight line advocates, owned one of the quarters in section 18 referred to by him; would he not think it doing him great injustice in taking off 3.64 acres that made his quarter equal to his neighbor's, and give it to some one who never bought it? For the other man claimed only a quarter; then why give him 3.64 acres more and other less? *I will not do it* until I see a decision of a supreme court that has a right to interpret the law for me.

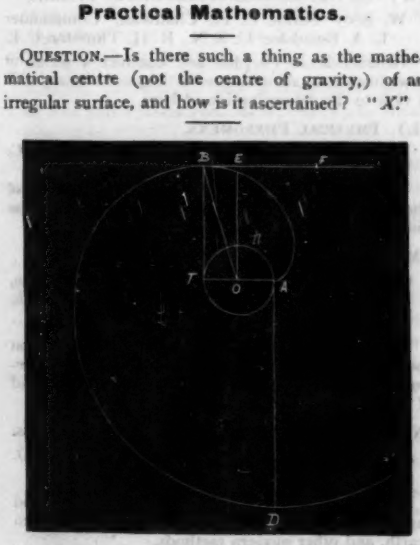
Will J. M. tell us who discovered that the law of Wisconsin "was in direct conflict with the Act of Congress?" I have been watching the decisions of the courts published in the NEWS, and I have seen nothing like it. On the contrary, there is a decision published on the 45th page, June number, 1874, in direct accordance with the equal area system. By referring to page 44, same number, you will see that the equal area system shows itself even in those who oppose it. See answer No. 1. That is going further in equal areas, than I could go.

J. M. thinks that in the original surveys none of the half section lines were run. If that be true, what is the meaning of the expression "or subdivisions for which they were intended?" Does not that imply that some of the half section lines were run? Is it reasonable to suppose they would run a straight line through the center of a section without making a corner equidistant? thus effectually dividing the section into quarters, contrary to the straight cross line theory.

On page 33, seven lines from the bottom, you make my first article read different from what was intended, by putting in the word "*not*." On the same page, in speaking of random lines, you make me say 129, whereas it ought to be 172. Send me THE NEWS for another year. J. VAN B.

Practical Mathematics.

QUESTION.—Is there such a thing as the mathematical centre (not the centre of gravity,) of an irregular surface, and how is it ascertained? "*X*."



MR. EDITOR:

In the problem of the March number, it is evident that the horse would travel just as far in winding off, as he would in winding one circumference from the post, and for brevity of diagram I have represented one circumference wound off. The horse starts from A, and travels on the curve A B C D; the tangent point of the chord B T, starts from the same point A, and travels on the circumference of the post A *n* T A. The former is called the *involute*, the latter the *evolute*, and it is self-evident from the figure, that B T is tangent to the *evolute*, and perpendicular to the *involute*. Let the radius of the post O T $=a$, the radius-vector OB $=r$, BF, a tangent to the curve at B, OE $=p$, a perpendicular on the tangent $\angle$ OBE $=\varphi$, $s=$ length of the involute. Now TB and OE, being perpendicular to BE and TO: TE is a rectangle and the equation of the curve is $P=\sqrt{r^2-a^2}$. It is demonstrated in the Differential Calculus (Todhunter, Art. 310), that $\cos\varphi=\frac{dr}{ds}$, by trigonometry $\sin\varphi=\frac{P}{r}$, therefore $\cos\varphi=\frac{\sqrt{r^2-P^2}}{r}$: substituting and $\frac{dr}{ds}=\frac{\sqrt{r^2-P^2}}{r}$ and $ds=\frac{r\,dr}{\sqrt{r^2-P^2}}=\frac{r\,dr}{a}$. Integrating and we have $s=\int\frac{r\,dr}{a}=\frac{r^2}{2a}+C=\frac{a^2+P^2}{2a}+C$,

Now when $s=0$, $P=0$, and $C=-\frac{a}{2}$, substituting and $s=\frac{r^2-a^2}{2a}=\frac{P^2}{2a}$ and when $P=n2\pi a$, $s=n^2 2\pi^2 a=n^2\times 2\pi a\times\pi$, but $2\pi a$—one yard by the problem, therefor $s=n^2\pi$. This simple equation is true for all values of n, whether whole or fractional. Take $n=0$, then $s=0$ evidently a correct result, In the problem, $n=100$ and $s=31{,}415.92653$ yards.

J. N.

Engineering Notes.

At the close of the year 1874, New Haven had 30 391-1000 miles of completed sewers, of which one-fourth was 24 inch. The success of the sewerage system of that city seems to be well assured.

A Trigonometrical survey of the City of New Haven was made last year, and a new map of the city, 13x15 feet in size has been completed.

New Haven now has 10 575-1000 miles of paved streets, of which 7 672-1000 miles are Telford pavement. The City Surveyor is very decidedly in favor of that pavement, as constructed from the material at hand, and with the care that is given to them in that city.

The channels forming the outlets to Lake Muskoka, Ontario, were enlarged during the past year, and a dam and sluices constructed for the equalization of the waters of the lake, which at extreme height, has, hitherto, caused injury by submerging the lands around its margin, and at extreme low water has impeded navigation in that portion of the waters between Lake Muskoka and the lock at Port Carling. The total cost of the works were $8,999.76, or 24 cents less than the appropriation.

By the "Ontario Drainage Act of 1873," the cost of the drainage works undertaken by the Government is repaid to the Provinces by a rent charge on the lands unwatered, at a determined rate per annum for a specified number of years, for each $100 expended. At the close of the year 1874, there were in Ontario of drains completed, or under construction, 184¼ miles, by which 165,500 acres would be reclaimed at a total estimated cost, when finished, of $245,184, re payable by a rent charge of $7.61 per annum for 22 years for each $100 expended. Already some of the reclaimed lands have risen in value from $10 to $30 per acre. As these beneficial results become known throughout the Province, numerous applications for similar works are being made by various Township councils, and surveys are being made.

SARNIA, COUNTY OF LAMBTON.—The work now under contract in this township comprises the enlargement of the Wawanosh drain which is the chief outlet for the surplus rain-fall for the township. Some years ago the township authorities cut the Wawanosh drain (under a special Act), from what was then called the Cull drain on front Lot No. 24, to the western boundary of Lake Wawanosh. This comparatively drained the lake—so much so that the Township Council laid out its surface into lots and sold them. They afterwards, on petition from the resident landholders, continued the drain southwards, the landholders paying a large proportion of the cost of construction. This work had the effect of again flooding the Wawanosh Lake bed together with a considerable extent of the surrounding cedar and tamarac lands, in the freshets prevailing during the wet seasons of the year, thereby giving the parties holding the lands affected, grounds for action against the Corporation. The work now in progress of construction it is hoped will relieve the lands still subject to flood by given a sufficient area to the drain to enable it to carry off the flood water without overflow. The drain as it will be enlarged, will have a bottom width of 22 feet from the upper end of Lake Wawanosh to its outlet, and through the lake an embankment will be formed on each side of the ditch, having a berme of four feet between the base of the bank and edge of the cut forming the ditch. The top of the bank will be four feet above the surface of the lake bed, and average nine feet above the bottom of the drain. The width of the water area between the tops of the banks, will be 52 feet, and its sectional area 319 square feet, the average sectional area of the old drain crossing the lake bed being only 90 square feet. Outside the embankments there will be other bermes and parallel drains connecting with the main drain by box culverts with trap doors, which will be so placed as to shut themselves when the water in the main drain is higher than that in the side drains. This arrangement is intended to drain the lake bed, while at the same time it will relieve it from being flooded by the freshets passing down the main drain. The excavations required in the progress of the work will be about 60,000 cubic pards, and the contract has been let for 18½ cents per cubic yard, which covers the removal of everything from the site of the work, as well as all excavations of material, and formations in embankments. Eight culverts will be required in the embankments, and they will form additional contracts.

A lock is being built on the north branch of the Muskoka River, Ontario, which it is expected will be completed this season, and when finished will open a navigation from the foot of Mary's Lake, 13 miles by road, *via* Utterson, from Bracebridge, up the north branch of the Muskoka River into Fairy, Vernon, and Peninsula Lakes. These waters are now surrounded by promising settlements, the country around having a considerable per centage of good land interspersed amongst the high rocky hills. The village of Huntsville is built on the margin of one of the lakes, and is very picturesquely situated. The contract for the work was let at $16,900.

Stevens Institute of Technology,
Department of Engineering.

U. S. Commission on Test of Iron, Steel, etc.

DEAR SIR:

The Commission appointed by the President of the United States to experiment and report upon the metals used in construction, desires to secure the assistance of all who are interested in this great work, and through them to obtain all information available as the result of the labors of carlier, or of contemporaneous, investigators and observers.

I take the liberty of enclosing herewith circulars indicating the scope of the labors undertaken by this Commission, and beg that you will aid, by such methods as may be by you deemed best, in the collection of all information which may be accessible, relating to either to the general work of the Commissioners, or to the special subjects assigned to its committees.

Data collected in the course of ordinary business practice, and the record of special researches previously made or now in progress, are particularly desired.

It is expected that the Commission will receive valuable information and useful suggestions, both from business men and from men of science, and it is hoped that the work undertaken, as here indicated, may be supplemented by original investigations made by both these classes.

The national importance of this work justifies the expectation of an earnest and effective co-operation.

Very respectively yours,
R. H. THURSTON, Secretary.

A. *Committee*—R. H. Thurston, A. L. Holley, D. Smith, U. S. N., U. S. Board appointed to test Iron, Steel, etc.

The United States Board to Test, Iron, Steel, etc., appointed by the President of the United States, in accordance with Section 4 of the Act of Congress, making appropriations for sundry civil expenses of the Government, and approved March 3, 1875, has assumed, as a part of its work, the investigation of the methods and effects of ABRASION AND WEAR of metals in engineering and mechanical operations.

This Committee is instructed to take up this subject and to report such valuable data and statistics, and such information as it may acquire by experiment or from other observers, in such form that it may be readily collated and made useful to the Government, the public, and the engineering profession.

The Committee would be pleased to receive from any reliable source such precise data and such information as may enable the Secretary to compile, in as concise and exact form as possible, a statement of the mode of deformation, the rapidity of abrasion, and the laws governing wear in any important typical or exceptional cases.

The executive officers of all lines of railway may render valuable aid by furnishing statements of the wear of rails per ton of transportation, specifying with care the original weight, the make, and the character of the rail, the total amount of transportation, the length of time occupied, and stating whether the rail finally broke or was removed. Specimens of rails remarkable either for endurance or for a lack of this quality, if sent to the Committee will be of use in assisting in the determination of the chemical and other properties which most affect the value of the material under the stated conditions of use.

Similar statistics and information in regard to the wear of wheels, axles, and other parts of rolling stock and machinery will be equally valuable.

Engineers having in any instance noted and accurately recorded such data, are requested to transmit to this Committee copies of their memoranda.

The wear of journals under heavy loads, or at high velocities, as well as under ordinary conditions, is an important branch of this subject. When possible, it is desired that the dimensions of the journal, the maximum, the minimum, and the mean weight sustained, and the velocity of rubbing or number of revolutions per minute should be given. The nature of the lubricant is an essential element, and its composition should be stated, the method and frequency of application, and the quantity used should be given. When known, or readily ascertained, the co-efficient of friction should be given. It should also be noted whether heating occurs, and under what circumstances of pressure and velocity of rubbing surface.

Peculiar instances of the behavior, or unusual expedients in the management of, bearings, if described accurately and concisely, will be accepted, with thanks.

The wear of tools, under the various conditions of workshop practice, is another subject of investigation.

Weighing the tools carefully before and after use, and weighing the amount of metal removed, will, perhaps, be found the most accurate method of determining the rate of abrasion. The area of surface finished, and the area of the surface cut by the tool should be accurately ascertained and stated.

The description of the tools, its shape, method of operation, the kind of metal used in the tool, the temper adopted, the character of the metal cut by it, the velocity of the tool, and where peculiarities of behavior were noted, a careful statement of them should be given. This information will still be more valuable if the tool itself and specimens of the chips produced by it are furnished.

The power required to drive the tool can sometimes be readily determined, and such information is of great value.

The recent investigations of M. Tresca—*Memoir Sur le Robotage des Metaux*, etc.—is an excellent example of such research.

For all information which may properly fall within the limits of their investigation, this Committee will return suitable acknowledgment.

ORGANIZATION OF THE U. S. BOARD APPOINTED TO TEST IRON, STEEL, ETC.

Lt. Col. T. T. S. Laidley, U. S. A., President; Commander L. A. Beardslee, U. S. N.; Lt. Col. Q. A. Gillmore, U. S. A.; Chief Engineer David Smith, U. S. N.; W. Sooy Smith, C. E.; A. L. Holley, D. E.; R. H. Thurston, C. E., Secretary.

This Board is appointed by the President of the United States, in accordance with the provisions of Section 4, of "An Act making Appropriations for Sundry Civil Expenses of the Government, for the fiscal year ending June 30th, 1876, and for other purposes," approved March 3d, 1875.

It is instructed to determine by actual tests the strength and value of all kinds of iron, steel, and other metals which may he submitted to it, or by it procured, and to prepare tables which will exhibit the strength and value of said materials for constructive purposes.

STANDING COMMITTEE OF THE BOARD.

(A) On ABRASION AND WEAR.

R. H. Thurston, C. E., Chairman; A. L. Holley, C. E.; Chief Eng'r D. Smith, U. S. N.

Instructions:—To examine and report upon the abrasion and wear of railway wheels, axles, rails, and other materials, under the conditions of actual use.

(B) On ARMOR PLATE.

Lieut. Col. Q. A. Gillmore, U. S. A., Chairman; A. L. Holley, C. E.; R. H. Thurston, C. E.

Instructions:—To make tests of Armor Plate, and to collect data derived from experiments already made to determine the characteristics of metal suitable for such use.

(C) On CHEMICAL RESEARCH.

A. L. Holley Chairman; R. H. Thurston, C. E.

Instructions:—To plan and conduct investigations of the mutual relations of the chemical and mechanical properties of metals.

(D) On CHAINS AND WIRE ROPES.

Commander L. A. Beardslee, U. S. N., Chairman, Lt. Col. Q. A. Gillmore, U. S. A., Chief Eng'r D. Smith, U. S. N.

Instructions:—To determine the character of iron best adapted for chain cables, the best form and proportions of link, and the qualities of metal used in the manufacture of iron and steel wire rope,

(E) On CORROSION OF METALS.

W. Sooy Smith, C. E., Chairman, Lt. Col. Q. A. Gillmore, U. S. A., Commander L. A. Beardslee, U. S. A.

Instructions:—To investigate the subject of the corrosion of metals under the conditions of actual use.

(F) On THE EFFECTS OF TEMPERATURE.

R. A. Thurston, C. E. Chairman, Lt. Col. Q. A. Gillmore, U. S. A., Commander L. A. Beardslee, U. S. N.

Instructions:—To investigate the effects of variation of temperature upon the strength and other qualities of iron, steel, and other metals.

(G) On GIRDERS AND COLUMNS.

W. Sooy Smith, C. E. Chairman, Lt. Col. Q. A Gillmore, U. S. A., Chief Eng'r D. Smith, U. S. N.

Instructions:—To arrange and conduct experiments to determine the laws of resistance of beams, girders and columns to change of form and to fracture.

(H) On IRON, MALLEABLE.

Commander L. A. Beardslee, U. S. N., Chairman, W. Sooy Smith, C. E,, A. L. Holley, C. E.

Instructions:—To examine and report upon the mechanical and physical proportions of wrought iron.

(I) On IRON, CAST.

Lt. Col. Q. A, Gillmore, U. S. A., Chairman, R. H. Thurston, C. E., Chief Eng'r D. Smith, U. S. N.

Instructions:—To consider and report upon the mechanical and physical properties of cast iron.

(J) On METALLIC ALLOYS.

R. H. Thurston, C. E., Chairman, Commander L A. Beardslee, U. S. N., Chief Eng'r D. Smith, U. S. N.

Instructions:—To assume charge of a series of experiments on the characteristics of alloys, and an investigation of the laws of combination,

(K) On ORTHOGONAL SIMULTANEOUS STRAINS,

W. Sooy Smith, C. E., Chairman, Commander L. A. Beardslee, U. S. N., R. H. Thurston, C. E.

Instructions,—To plan and conduct a series of experiments on simultaneous orthogonal strains, with a view to the determination of laws.

(L) PHYSICAL PHENOMENA.

W. Sooy Smith, C. E., Chairman, A. L. Holley, C. E., R. H. Thurston, C. E.

Instructions:—To make a special investigation of the physical phenomena accompanying the distortion and rupture of materials.

(M) On RE-HEATING AND RE-ROLLING.

Commander L. A. Beardslee, U. S. N., Chairman, Chief Eng'r D. Smith, U. S. N., W. Sooy Smith, C. E.

Instructions:—To observe and to experiment upon the effects of re-heating, re-rolling, or otherwise reworking; hammering, as compared with rolling, and of annealing the metals.

(N) On STEELS PRODUCED BY MODERN PROCESSES.

A. L. Holley, C. E. Chairman, Chief Eng'r D. Smith, U. S. N., W. Sooy Smith, C. E.

Instructions:—To investigate the constitution and characteristics of steels made by the Bessemer, open hearth, and other modern methods.

(O) On STEELS FOR TOOLS.

Chief Eng'r D. Smith, U. S. N., Chairman, Commander L. A. Beardslee, U. S. N., W. Sooy Smith, C. E.

Instructions:—To determine the constitution and characteristics, and the special adaptations of steels used for tools.

The above named Committees of this Board are

appointed to conduct the several invertigations, and the special researches assigned them in the interval during which the regular work of the Board is delayed by the preparation of the necessary testing machinery, and during such periods of leisure as may afterward occur.

These investigations are expected to be made with critical and scientific accuracy, and will, therefore, consist in the minute analysis of a somewhat limited number of specimens and the precise determination of mechanical and physical properties, with a view to the detection and enunciation of the law connecting them with the phenomena of resistance to flexure, distortion and rupture.

The Board will be prepared to enter upon a more general investigation, testing such specimens as may be forwarded to the President of the Board, or such as it may be determined to purchase in open market, immediately upon the completion of the apparatus ordered, at which time circulars will be published giving detailed instructions relative to the preparation of specimens for test, and stating minutely the information which will be demanded previous to their acceptance.

R. H. THURSTON
Secretary of the Board

PUBLICATIONS RECEIVED.

From the Institution of Civil Engineers, London England :—

REPORT OF PROCEEDINGS at the Fifty-Seventh Annual Meeting of the Institution, held December 22d, 1874. London, 1874.

ABSTRACT OF PAPERS in Foreign Transactions and Periodicals. London, 1875.

NOTES ON THE PUBLIC WORKS in the United States and in Canada, including a description of the St Lawrence and the Mississippi Rivers, and their main Tributaries. By Sir Charles A. Hartley, M. Inst. C. E., F. R. S. E. London, 1875

NOTES ON THE CONSOLIDATION OF EARTHWORKS. By Jules Gaudard, C. E., Lausanne. Translated from the French, by James Dredge, C. E. London, 1875.

THE PENNSYLVANIA RAILROAD ; with Remarks on Railway Construction and Management. By C. D. Fox and Francis Fox, M. M. Inst. C. E. London, 1875,

THE CONSTRUCTION OF GASWORKS. By Harry Edward Jones, Assoc. Inst. C. E. London, 1875

PETROLEUM, and other Mineral Oils, applied to the Manufacture of Gas. By O. C. D. Ross, M. Inst. C. E. London, 1875.

ON THE ORIGIN OF THE CHESIL BANK, and on the Relation of the existing Beaches to past Geological changes, independent of the present Coast Action By Jos. Prestwich, M. A., F. R. S. V. P. G. S., Assoc. Inst. C. E., Prof. of Geology in the University of Oxford. London, 1875.

THE EROSION OF THE BORE IN HEAVY GUNS, and the means for its prevention ; with Suggestions for the Improvement of Muzzle-loading Projectiles By. Chas. Wm. Lancaster, Assoc. Inst. C. E. London, 1875.

CURVE OF EQUILIBRIUM FOR A RIGID ARCH UNDER VERTICAL FORCES. By George Fuller, Assoc. Inst C. E. London, 1875.

THE NAGPUR WATERWORKS, with Observations on the Rainfall, the Flow from the Ground, and Evaporation at Nagpur; and in the Fluctuation of Rainfall in India, and in other places. By Alex. R. Binnie, M. Inst. C. E. London, 1874.

RE-CONSTRUCTION OF BRIDGES ON THE DELHI RAILWAY. By Chas. Stone, M. Inst. C. E. London, 1875.

ON ENGINEERING IN SWEDEN. By Christer Peter Sandberg, Assoc. Inst. C. E. London, 1875.

THE NEW SOUTH BREAKWATER AT ABERDEEN By William Dyce Cay, M. Inst. C. E., and the EXTENSION OF THE SOUTH JETTY AT KUSTENDJIE. By Geo. Lenton Roff. London, 1875.

From Chas. E. Fowler, City Surveyor—

ANNUAL REPORT OF THE STREET DEPARTMENT, of the City of New Haven, Conn., for the year ending Dec. 31. 1874. New Haven, 1875.

From. A. Willson, C. E., Toronto—

ANNUAL REPORT OF THE COMMISSIONER OF PUBLIC WORKS, for the Province of Ontario, for the year 1874. Toronto, 1874.

TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, for May, 1875.

LAWS, RULES, AND INSTRUCTIONS relating to the duties of County Surveyors of the State of Iowa. Compiled by C. C. Carpenter, Register of State Land Office. Des Moines, 1870.

EFFICIENCY OF FURNACES BURNING WET FUEL, as determined by experiments on a large scale. By Prof. R. H. Thurston, Am. C. E. Philadelphia. 1875.

REPORT of the Officers of the City of Burlington, Iowa, for the year ending March 3rd, 1875.

REPORT of Samuel McElroy, C. E. Submitted to the Town Survey Commissioners of Kings County, Oct. 31, 1874. Brooklyn, 1874.

A considerable number of complaints have been received from subscribers who did not get the May number of the NEWS. It is very unpleasant for us to have anything of the kind occur. We printed our usual edition in May, and in consequence of the editorial notice given to subscribers who did not renew before our June issue, were especially careful to send a paper, well wrapped and correctly addressed, to every name on our list, and we can assure our friends that the miscarriage of the paper was no fault of ours. We have laid the matter before the Post Office authorities, and hope there will be no mishaps in the future. We may at this time take the opportunity to assure our subscribers that we have been especially careful, from the first, in directing and mailing our journal, and until the past month, have not received many complaints. We try to be ready by our advertised publishing day, but cannot always accomplish it, but subscribers who do not receive their paper within one week from that date will please to notify us promptly so that we may notify the Post Office Department. Those who do not receive the June number will first consider whether the balance of this year's subscription has been paid by them before inquiring why their paper does not come.

Charles Howard & Co., manufacturers of sewing machine needles, Brockton, Mass., have an automatic milling machine for turning needle blanks, an invention of their own, which, it is said, is superior in its work, and produces three times as many needles as by the way in use in the other factories.

BOARD OF PUBLIC WORKS,

CHICAGO MAY 24, 1875.

SPECIFICATIONS for the Excavation and Masonry for Branch Tunnels, and Foundations for the New Engine and Engine House,

To be erected at the site of the New Water works at the termination of the extension of the New Lake Tunnel under the city. The site being designated as lots Nos. 1, 2, 3, 4, and 41, of Block 10 in S. J. Walker's Dock Addition to Chicago, the same being on Ashland Avenue, near Twenty-Second Street.

OFFICE BOARD OF PUBLIC WORKS,
Chicago, May 25th, 1875.

There will be one tunnel of the length of 104 feet, 7 feet wide, and 7 feet 2 inches high, with brick work of 12 inches thick, set in three rings of four inches each, and will commence at the five feet eye of the present shaft, which shaft is on the ground of the contemplated New Water Works. This tunnel will connect with a tunnel 15 feet high by 7 feet wide in the clear, with brick masonry, as shown on drawings, and will be 28 feet in length. These tunnels will be horizontal and carried on the same level as shown on plan being at the inverts 29 feet below city datum line, or about 38 feet below the present surface of the lots. It is supposed that parts of the inverts will have to be constructed in connection with a rock bottom. The masonry of these tunnels to be of good sound hard burned sewer brick, and mortar composed of equal parts of hydraulic cement and sand.

The excavation is supposed to be in good firm clay, with part rocks at the inverts, to be of the form and dimensions as shown on drawings; but there will probably be springs of water near the rock, and there may be pockets of quick sand, or boulders, or other troublesome ground, all of which the contractor must take at his own risk.

The masonry for the foundations of the engine to be composed of Rubble, Block Stone, and of Cut Dimension Stone, from the Lemont or other quarries, to be of the form and dimensions as marked and shown on drawings, to be set or laid in uniform courses. The block and cut stone to have top and bottom beds and vertical joints, dressed in the best manner, with a uniform surface throughout. The stone for the block and cut stone masonry will be on an average of 6 feet long and 12, 18, and 20 inches in thickness. The whole of this work is to be bound together with vertical wrought iron bolts, the holes of which will require to be drilled in the most accurate manner, after the masonry is ready to receive the bolts. The number of bolts, with their dimensions and positions to be inserted, to be as shown on drawings. Such spaces, apertures, or openings necessary for the bolts, pipes, &c., to be constructed as may be directed, and included in the price per cubic yard without any extra charge.

The cut stone masonry to be of pitched-faced Ashler, with chisel dressed margins on the quoins, the margins to be one inch wide. The mortar to be used in the masonry to be composed of equal parts of hydraulic cement and clean sharp sand. This masonry must be constructed in the very best and most durable manner, all the stones must be of the best discription, set on their natural beds, and free from any kind of imperfection. The rubble masonry will commence on the bed rock for its natural foundation, and all of the work be carried up in such courses as marked and shown on the drawings, and as may be directed. All the large stones must be set on their beds with a lewis, and the stones to be laid on a full bed of mortar.

The brick masonry to be of the same quality as specified for the tunnels.

The excavation for the masonry, of the engine, to be taken out to the bed rock, the depth from the surface of the ground being about 37 or 38 feet, varying in the depth.

In case the rock should be encountered in the prosecution of the excavation for the tunnels, the contractor will have to state in the proposal his price per cubic yard for rock cutting.

There are estimated to be 7,705 cubic yards of excavation in clay, 2,980 cubic yards of stone masonry, and 1,463 cubic yards of brick masonry, 226 oak piles 32 feet long, of an average diameter of 12 inches, and 10,950 feet B. M. of oak waleings, 8 inches by 12 inches, sawed to these dimensions.

The excavation including all pumping and bailing, and the masonry to be contracted for by the cubic yard. The tunnels to be by the lineal foot.

The contractor to provide all materials, bracing, scaffolding, machinery, pumps and pumping, and all bailing and bailing apparatus at his own expense, without any extra charge of any kind for the work as specified in these specifications, and as marked or shown on drawings, or as may be directed.

The material taken from the excavation to be deposited on the premises as may be directed, and to be the property of the city. Such material to be spread and leveled uniformly over the surface of the ground.

The bearing piles designed for the foundation of the engine house will be of oak, sound, straight, and free from all defects, and to be 32 feet long, not less than 10 inches diameter at the small end, nor 15 inches at the large end. They will be properly sharpened and banded, and driven as directed by the engineer in charge. Piles in each row will be driven at intervals of 3 feet from centre to centre. After the piles are driven the tops to be cut to receive the waleings, which are to be placed as shown on drawings.

The waleings to be of oak timber 8 inches by 12 inches, to be straight and sound, free from wains, shakes, splits, decayed knots, or other imperfections, and shall be sawed to the dimensions called for in these specifications, or shown on drawings. All timber to be free from decayed knots or other defects, straight grained and best quality of lumber.

Girder, bolts, tie rods, &c., shall be of the best quality of American wrought iron, free from all defects. Castings shall be of the best quality of iron, free from all flaws, blisters, or other defects.

Hydraulic cement must be fresh and well ground, and of a quality equal to the best Akron or Utica cement.

The whole of the masonry to be built according to the plans and sections, and will be estimated and paid for by the cubic yard. No constructive measurement will be allowed, and only the actual quantity required by the prescribed dimensions will be allowed and paid for. The price for masonry per cubic yard shall in every case include the furnishing of all materials and the cost of scaffolding, centering, bracing, bridging, and all other cost and expenses incidental to the completion of the masonry.

The whole of the work included in these specifications to be under the immediate charge of such engineer or superintendent, aided by such assistants and inspectors as the Board of Public Works may appoint, and all directions of such engineer or superintendent must be obeyed by the contractor unless said Board should countermand them.

All of the above specified work to be constructed in accordance with the drawings and these specifications.

The Board of Public Works to have the right to increase or diminish the amount of any kind of work mentioned in these specifications, the additions to be paid for, and deductions for work omitted to be paid for, and deductions for work omitted to be made according to the rates for the same in the proposal hereto annexed.

The whole of the work to be completed on or before the first of September, A. D. 1875.

Perhaps the heaviest piece of main line traffic in the world is that on the London and North Western Railway between London (Euston station) and Rugby—a section 83 miles long. On this section the following trains run through: 30 express trains at 40 miles an hour; 5 at 36 miles an hour; 29 passenger trains at lower speeds and stopping at all stations; 32 express goods trains at 20 to 25 miles an hour; 27 ordinary goods trains, and 23 local goods and mineral trains—a total of 64 passenger and 82 freight trains in 24 hours.

Notes on Heat.

An alloy of three parts tin and 8 parts bismuth melts at a temperature less than that of boiling water.

Mr. Stephenson once stated that in consequence of laying three or four miles of line, near Petersborough, with close joints, the heat of the sun, on a warm day, caused such an expansion, that the rails and sleepers were lifted, on one place, from the ballast, so as to form an arch, 50 feet long and 3 feet high, in the air.

The accumulated expansion of a considerable length of saddleback rail closely rivetted together, on the Keating and Basingstoke line, was such as to throw the line out of place a foot vertically and some distance horizontally.

The visible expansion of the mercury in a thermometer is the difference only between the total expansion of the mercury and that of a glass tube.

High temperatures are measured with ordinary steam pressure gauge by connecting it, by means of a platinum tube, with a hollow ball of platinum filled with air. The ball being exposed to heat, the air within it is expanded, and the pressure corresponding to its temperature is shown on the gauge.

Stag bolts in locomotive furnaces have been rendered crystalline and have broken from slight but repeated bendings, produced by the different rates of expansion of the outer and inner fireboxes.

Water may be boiled in an egg-shell, or in a box, the bottom of which is made of card paper; and if the circulation of the water is unrestricted, the fragile material of the boiler, although held directly in the flames, will be uninjured.

An alloy compose of nine parts lead, two of antimony, and one of bismuth, will expand in cooling, and is therefore sometimes used for filling blow-holes in iron castings.

A French apparatus for boiling water and cooking by friction, and without fuel, consisted of a conically bored brass ring, in which was revolved a truncated wooden cone, surrounded with plated hemp, which was kept constantly saturated with oil. The heat was produced by the friction between the hemp and the brass.

The specific heat of iron is .1137, that of water being unity.

The heat which would rise 1 lb. of water, through any number of degrees of temperature would heat 9 lbs. of iron to the same extent.

In South America, very sensitive barometers are made by glueing together strips of red cedar and seasoned pine, as follows: A strip of cedar about 30 ins. long, 1½ in. wide, and ⅛ in. thick, is cut with the grain, and to one side of it are glued strips of pine of equal thickness, with the grain running transversely to that of the cedar. The compound strip is set on end, and according to the state of the atmosphere, it will bend over more or less to one side.

The hands when covered with a slight moisture, have been dipped, without injury into melted iron.

Mercury congeals at 38.6° Fahrenheit below the zero of that scale, or at about 70° of "frost." The greatest artificial cold ever produced is stated by Faraday at 135° below zero. At the latter temperature alcohol did not freeze. The greatest atmospheric cold, as ascertained by a spirit thermometer, was stated by Black at 77°, by Ross, at 60°, and by Perry, at 55°. The lowest temperature in 1859, at the works of the Victoria Bridge, Montreal was 42° below zero.

On the Elasticity of Permanent Way.

BY M. CAILLE.

Memoirs de la Societe des Ingenieurs Civils.

The Author refers to a communication read before the Society upon the specimens of permanent way collected in the Paris Universal Exhibition in 1867. In 1864, the late M. Flachat pointed out the necessity of increasing the weight of rails, because their deflection, between the points of support, was appreciable even beneath the wheels of passenger-carriages and goods wagons. A short time afterwards he observed that deflection destroyed the rails, and prevented any increase in speed, because increase of speed was only possible by increasing the weight of the rolling stock.

In 1864 the main French lines had adopted rails weighing from 68 to 75 lbs. per yard, and, for the most part, the size and distribution of the sleepers still remain the same. If these types are considered too light, and there is a tendency to increase their strength, the means hitherto adopted to preserve the integrity of the permanent way, and to prevent excessive deflection, are insufficient; but it does not follow that deflection of the rails within certain limits may not be permitted, without injury to the traffic. In the forty years during which the cross-sleeper road has been tried, it has proved itself the only one capable of economically fulfilling all the conditions of stability and security.

Upon this basis, the Author examines the construction of various types of permanent way, especially that with cross sleepers, and inquires into the conditions regulating their maintenance. During the first twenty years of railway history, when traffic was insignificant, weights small, and speeds low, single or double-headed rails, carried in suitable chairs spiked to the sleepers, resting on the ballast, answered all purposes. As these primitive conditions altered, modifications and improvements in the form of the permanent way followed of necessity. But the nature of the ballast, its distribution over the formation, and the possibility of increasing or reducing its mobility, do not appear to have been the subject of investigation. The importance of employing ballast has always been recognised, and different rails have been designed with the view of reducing its mobility, which, with all types of way, resulted in irregularity of bearing surfaces, highly destructive to the rails and rolling stock. To remedy this, packing was resorted to, with only temporary relief, the way remaining exposed to alterations in its normal levels. This led to an investigation directed especially to the weakness of rails, the excessive distance between the sleepers, the insecurity of the joints, and so forth. The flexure of the rails could be corrected in two ways; by increasing their weight, or by bringing the sleepers closer together. By preference the weights of the rails were increased—but insufficiently. As to the shocks sustained, by the ends of the rails under a passing load, the instability of the adjacent sleepers proved clearly, that it was necessary to prevent the flexure and sinking of these joints, and to unite the ends of the rails efficiently. Larger sleepers, placed more closely together, were introduced to meet the first difficulty; but in spite of all, the joints remain the weakest points of the permanent way. The temporary deflection of the rails under a passing load is not produced close to the load only, but at a distance on either side of its point of application, and the distance between the two points of deflection, and the point of contact of the load, increases with the rigidity of the rails.

It follows that regular deflection cannot exist unless the rails are uniformly rigid—a condition manifestly impossible. Thus, as the successive points of a rail sink before an advancing load, as the latter approaches the joint, the end of the adjacent rail is not able to continue the movement, and the joint forms, as it were a fixed point, and consequently a projection, which is struck by the load and produces a permanent sinking. The Author, after stating that joint chairs and joint chair sleepers have been abandoned, and that fishes are used, discusses the principles involved in the several classes of fish joints, each represented by many forms.

Turning upon the condition of permanent way upon French railways, he points out that, to obtain a uniform movement, of the rails and sleepers, the ballast should be as homogeneous as possible. If sand be employed, it must be pure and of regular quality; if stone, it must be evenly broken. Sand opposes a comparatively feeble resistance to passing loads, but it yields without reactions, and reduces to a sensible degree the effect of the blows upon the superstructure of the way. If the ballast be of bad quality, its mobility may be increased by rain, reduced by dryness, and destroyed by frost.

The best ballast is clean gravel; but considering the requirements of packing, a mixture of gravel and fine sand is preferable. Broken stone must be often used, but it should be very hard, evenly broken, and not mixed with earth. Packing is required on account of the mobility of the ballast, to prevent the sleepers from taking a middle bearing; to effect which, a space of from 12 inches to 30 inches is left unpacked in the centre. The packing is therefore made on both sides of each rail, to an extent varying with the nature of the material employed. With broken stone, the extent ranges from 4 to 6 feet for each sleeper; with sand ballast it is generally 6 feet 6 inches long. The packing thus introduced may be regarded as a wedge, serving to restore the sleepers to their normal level. But the operation reduces the areas of support, and transfers the pressure to the lower bed of ballast, which is less mobile than that actually carrying the sleepers. These supports, therefore, should have an equal extent, and be equally distributed on each side of the rails; a condition rarely met with when the sleepers are good, and never when old and new cross-ties are mingled. It is necessary to give the superstructure a support, not only permeable, but uniform, to secure regularity in the vibrations of rails and sleepers.

Irregularity of movement in rails is due to imperfect fishing, to faults of construction, to defective laying, and to uneven wear, if they be of iron. Among the detailed causes of irregularity of the road are—the cutting into sleepers by chairs, or by the base of the rail, the flexure of the latter, and the gradual enlargement of the holes in the sleepers into which the pins or trenails are driven to secure the chair or rail. The cutting into the sleeper in straight lengths of way creates an inward inclination of the rails, which falsifies the guage; while on curves, the reverse take place.

Immobility in permanent way must result in its rapid destruction; but it may be useful to direct attention to the causes which led to the failure of certain modifications, seeking to impart greater rigidity, and thereby to reduce elasticity. Comparative rigidity can be obtained either by employing a cross-sleeper road, with rails of sufficient stiffness; by giving to the rails rigidity and bearing surface large enough. as in the Barlow system, to secure the immobility of the ballast; or by placing the rails on longitudinal sleepers of such an area that the ballast shall remain undisturbed. The same result can be obtained in a cross-tie road, either by augmenting the stiffness of the rail by increasing the number of sleepers, so that the passing load is distributed over a sufficient number of the ties, or by laying the superstructure of either type upon rock, beton, or masonry. All permanent way should be considered as a compound structure, essentially required to accommodate itself to vibration and to the shocks of impact, which increase in intensity as the traffic increases in speed and weight. The best type is that which, giving full assurance of security, develops uniformly the greatest amount of elasticity. Practically, pure sand is incompressible when properly consolidated, and if the load be immovable. If the supporting surface is narrow, and the movement of the load put the sand in motion, the sleeper will penetrate till it meets with sufficient resistance to check further displacement. Experience shows that the permanent way requires frequent local packing up, and occasional general lifting and restoration. Part of the ballast can,

however, under certain conditions, resume its original state after the passing of the last load. To estimate the weight transmitted to the ballast, it may be assumed that the length of packing for each sleeper is 79 inches. The bearing surface, therefore, will be about 10 inches × 79 inches = 790 square inches, neglecting the resistance of the ballast in the unpacked parts. If it be assumed that the ties all sink under the load, that the rails are rigid enough, and the sleepers so close together as to prevent deflection of the rails between them, it may be taken that the load affects at least four sleepers according to the stiffness of the rails, and thus the total supporting area will be about 3,160 square inches for a supposed load of 26,000 lbs. The total weight on the ballast would thus be 8·2 lbs. per square inch. But it is a rapidly moving load acting upon a free vibrating frame, the rigidity of which is sufficient to allow the rails to resume their normal place after the load has passed. The supports of the rails, including the packing, will thus penetrate the ballast, and its penetration will increase in depth and uniformity as the vibrations transmitted are more intense, as the ballast is better and of more regular quality, as the bearing surfaces of the framework are more equally distributed, and as the frame itself is less massive.

To sum up the foregoing:—Permanent way, the arrangements of which cheks the vibration of its parts by too great or too little rigidity, or by the extent or ill-arrangement of its supports, develops immobility, hardness of ballast, and comparatively rapid destruction.

The double-headed rail, though it possesses the advantage that both tables may be used for traffic, is bad in form, and weak. Its inherent faults are not compensated by the advantage of reversing it, and this reversing indeed compromises the security of the road, destroys its elasticity, and favours abnormal deflection.

The Vignoles' rail, on the other hand, seems to combine security with durability. Resistance to rupture is ensured by the use of elastic iron of great tensile strength for the foot; and durability is obtained by employing hard iron for the head. But suitable iron is extremely difficult to procure, and the full advantage of the section can only be secured by employing steel. The Vignoles' rail, moreover, possesses greater transverse strength than the double-headed rail; it is also furnished in greater lengths, reducing the number of joints. In first cost, too, the advantage rests with the Vignoles' road in the proportion of from 5 to 7 per cent.

If a Vignoles' road be examined under a passing load, it will be noticed that its points of support have less motion than those beneath a double headed rail. This arises from the more numerous cross sleepers, and especially from the interruption in the transmission of vibration to the sleepers and ballast, due to the weakness of the connections. The way can preserve its regularity longer, but its rigidity is apparent whem exposed to impact. This regularity itself is only relative, changing constantly under the sinking and wear of the road. The stiffness and, to a certain extent, the transverse rigidity of the Vignoles' rail, and the method of securing it to the sleepers, aggravate the effects of the deviations, arising either from the wear of the rails, or from the state of the sleepers and ballast.

On account of the weakness of the joints, the Vignoles' rail requires careful examination, especially on curves. Experiments in France and in Germany demonstrate that these rails undergo temporary displacement during the passage of trains, and in this respect the Vignoles' rail possesses less security than the double-headed rail. Both have a tendency to assume an inclined position under the influence of the load, either inwards or outwards.

The deductions drawn by the Author are the following:—

1. That it is impossible to obtain absolute regularity by any system of permanent way.

2. That stability cannot be secured by immobility without sacrificing durability.

3. That permanent way can only be economical, when it is composed of durable materials possessing and retaining the necessary conditions of elasticity.

4. That, from this last point of view, the mobility of the ballast, however uniform and homogeneous, only supplies an irregular and insufficient means for developing the required elasticity.

5. That, moreover, the elasticity of permanent way does not exist at the joints, and can only be preserved thoroughout by the impracticable condition of maintaining the solidity of all the fastenings.

6. That the problem can only be solved by the adoption of a permanent way entirely of iron or of steel, which shall be elastic, yet possessing sufficient resistance, the flexibility of which shall be uniform at the joint and at the centre of the rail; where the stability—in a certain sense absolute—harmonizes with mobility, and the elasticity of which, independent of any assistance from the ballast, secures the preservation of the whole system.

The city of Chicago has awarded to the "International Pipe Company" of that city a contract for six thousand tons of new water pipe. The "International" is a branch of the Union Pipe Works of Louisville, and operated and owned by by E. P. Allis & Co., of Milwaukee, and Dennis Long & Co., of Louisville. The contracts amounts to nearly $250,000.

Survey of the City of Newport, R. I.

Newport, so celebrated as a fashionable watering place, has lately been surveyed, and we reprint a portion of the Report of Joseph P. Cotton, C. E., under whose superintendence the survey was made. The present population of the city must be about 20,000, yet, judging from the surveyor's remarks, it is without a system of sewerage, and there seems to be no uniform method of establishing street grades, or for regulating the platting of subdivisions in and adjoining the city. The Year Book, from which our extracts are taken, shows the city to be well supplied with public offices, but among them all that of a City Engineer is wanting. There are, however, five "Surveyors of Land," but the Reports do not show that they have anything to do with the public works of the city, which appear to be under the control of a "Superintendent of Streets and Highways." There are therefore no reports on sewerage and water supply, and the Mayor very properly expresses the public solicitude respecting the sanitary condition of the city, but can only recommend the cementing of vaults and other receptacles of refuse. Is it possible that Newport is so situated that engineering skill cannot devise a method for an adequate water supply, and an efficient plan of sewerage? The survey of the city was made in the season of 1873, between the months of February and November, and the platting of the work was completed the following spring, at a total cost of a little less than $5,000.

Mr. Cotton reports as follows:

The assessors' plats, 44 in number, are 36 by 45 inches, on white drawing paper. Twenty-three are on a scale of 50 feet to the inch; 18 on a scale of 100 feet to the inch; and 3 on scale of 200 feet to the inch. On these plats each lot as it was January 1st, 1874, is shown. The dimensions of the lots, as given in the deeds of transfer are on them in black figures; the dimensions as determined by our survey are in red.

The general map of the city, on a scale of 200 feet to the inch, is on two sheets of white mounted paper, each sheet 12 feet long by 5 feet wide, making a map 10 by 12. On this map each lot is shown, but not its dimensions. The dimension of the squares are given in feet and tenths. The elevation of the streets above mean low water is shown at each intersection in blue figures enclosed in a parenthesis. A map of the city published by Mr. C. E. Hammett, Jr., accompanies the assessors' plats,

with the boundary and number of each plat on it. This is intended to serve as an index to the plats. The dimensions of each lot when measured by us, are shown on these plats in red figures; the dimensions called for by deeds are shown in black figures.

In all cases where there were fences they were taken as the boundary lines of the estates; where there were no fences the deeds were referred to for the boundaries; and when these did not define the boundaries, one of the abuttors was usually consulted. It is not claimed that the property lines on these plats are in all cases correct, in fact, it would be impossible to have made them so in the estimation of all.

Many of the division lines in the older parts of the city cannot be defined by the deeds, because of the loose manner in which they have been drawn up. No permanent bounds having been established each abuttor usually considers that his neighbor occupies a strip of his land, and is ready with a long train of traditionary evidence in support of his views. This condition of affairs renders the making of plats of the estates in this city an unenviable task, for however well it may be done some will consider themselves aggrieved, and perhaps with cause.

A note has been added to the general map of the city, giving the manner in which the division lines were determined.

For the use of the Assessors of Taxes, a number of books, properly arranged to correspond with the plats, were procured, and in them an account with each lot was opened.

This account gives the number of the plat, the number of the lot, the area by our survey, the area by deed, the valuation of the land, the valuation of the improvements, owner's name, date of transfer, (to be filled when it is sold), number of square feet transferred, to whom transferred, the book and page of "Land Evidence," on which the transfer is recorded. All of the lots in the city as they were January 1st, 1874, are entered in these books, with the value as placed upon them by the assessors in their revaluation. These books, if properly kept, will be an abstract of title of each lot, which in time will be of great value.

Profiles of nearly all the streets have been made and accompany the maps.

The note books of the survey show the condition and kind of streets, kind and extent of sidewalks, location of street-crossings, of sewer-eyes, of lamp posts, and approximately, shade trees and buildings. These notes were not all called for by the survey as planned, but they were taken during the progress of the work with but little loss of time. Should the city decide to establish street and grade lines they would have nearly all of the information requisite in these books.

During the progress of the survey, I have been frequently called upon to give the grade of streets; my answer has been that I do not know that there is a street in the city with the grade established by an ordinance of the council.

It is the practice for the street commissioner to give grade lines when a street is improved under his direction, and the grade established by him is not always considered as fixed by his successor. It is not an unusual thing for the grade of a street to be changed after the property-holders have improved their grounds, rendering all their labor and expense useless. If the city, in its corporate capacity should establish grades in every street, and require that all future buildings shall be built to conform to this grade, the changes from the present to the new grade would be attended with but little expense. If grade lines are established, the street lines should be definded at the same time. On many of the streets the property lines on the streets are very irregular, and there are no marks or bounds defining the street lines. If the buildings over any considerable portion of the city should be burned it would be a very difficult matter to get a starting point from which the streets could be restored. This is a matter that demands early attention, and the sooner it is done the less will be the expense attending it.

When a tract of land is cut up for house lots, streets are opened with the sole object of making the greatest number of saleable lots, the question of drainage or public convenience seemingly having no weight whatever. Lots are sold, houses built, and the grounds graded and sodded from this street. In a little time the people living upon this street petition the council to take a deed of it and grade and curb it, which costs much more than it would have done if the street could have been taken before the ground was broken.

It would seem to be policy for the city when a street is to be opened, to require a plat of the same, with its connections and a profile of it with the elevation of the streets with which it connects at the point of intersection, to be submitted to them. Should the location meet with their approval, grade lines should be established to guide the property owners in planning their improvements. This could be done without accepting the street, and it would be of great value to the property owners.

One of the chief objects of this survey was to obtain the data upon which a system of sewerage could be devised. We think it gives all that is required for the perfecting of a plan.

During the progress of the survey the question of sewerage has been frequently brought to my notice by the complete absence of any intelligent efforts for drainage in many parts of the city.

That our city has not been visited by epidemics should not deceive us. The danger is real, and unless some steps are soon taken to remedy the existing evils, we shall certainly have cause to rue the delay. The sewers thus far built, are, with but few exceptions, only water courses, planned to drain the road bed. Had they never been called sewers and been used only for what they were designed, the danger from them would not be so great, but they have been entered by sink and privy drains in almost every street where they have been constructed. In the summer season when but little pure water finds its way into them the heavy material is deposited, and in a few days putrefaction commences, and deadly gases are generated. The sewers, built to drain the street only, offer no barrier to their escape, and were it not that the soil is so nearly impermeable, the results attending this condition of things would have long since aroused the people of Newport to a proper realization of the importance of this subject.

In streets where there are no sewers, or where the abuttors have not entered them, what provisions are made for the disposition of fœcal matter and kitchen drainage? In the majority of cases the privy vaults and cesspools are simply pits dug in the earth, with corner posts and a few planks nailed to them to keep the earth from falling in, and the owners will tell you that this is the cheapest way to construct them, as the first cost is less and they do not have to be cleaned more than once a year, while the tight ones must be cleaned every two or three months.

The question of convenience alone decides their location, and this same desire to have things convenient often locates the well within a few feet of the privy or cess-pool. Speak to them upon this subject and the will tell you that they were very careful to put the well above (up hill) all of their vaults. An examination will probably reveal the fact that the water in the well is several feet below the bottom of the vaults. I have been informed that the vaults of the Bellevue and Fillmore houses were dug to the water-bearing stratum, and that the wells as far away as High street were so much contaminated that they (the wells) had to be abandoned.

Is it not time that something was done when, in a thickly settled part of the town, an abandoned well is used for a privy vault? And yet such an instance has come to my notice, and I am informed it is not an exceptional thing. If wells several hundred feet from vaults are spoiled by them, is it probable that those in the neighborhood of the one above mentioned can escape pollution?

The government must keep its streets passable, and is liable for damages in case of accidents caused by their neglect. Shall it not then look after the drainage,

the neglect of which is the direct cause of more sickness, misery and death, than bad highways can be?

The capital of the laboring man is his health, and the capital of the individual is the capital of the State. Is it not then advisable for the State to take such measures as shall increase its capital?

How can it better do this than by giving to its people sewerage on correct principles? Will Newport take the first step in this matter which so vitally concerns us all?

The "Fever-Tree."

The *eucalyptus*, or blue-gum tree of Australia, was discovered by a French scientist, LABILLARDIERE, who visited Van Diemen's Land, in 1892. The great size and beauty of the tree soon gave it a place in the botanical gardens of Europe. Its medicinal qualities, however, for which it is now so famous, do not seem to have become known until about thirty years ago. The colonists of Tasmania used it for a great variety of purposes, but were ignorant of its power as an antiseptic. This was apparently discovered in Spain. In 1860, the neighborhood of the city of Valencia was planted with the eucalyptus. A marked improvement in the healthfulness of the locality followed. The Spaniards forthwith dubbed it the "fever-tree." It was soon afterwards introduced into Algeria, the climate of which seems to be especially adapted to it. It may fairly be said to be naturalized there, at the Cape of Good Hope, in the La Plata States of South America, and in California. Outside of these climates, it leads a precarious life. After a trial for many years in Southern France, it has failed, as a rule to become hardy, or to suck up and destroy the poisonous vapors of the swamps in which it was planted. The few dozen specimens planted within the walls of Rome are nearly all alive, but very few of them are vigorous. Within a year or two, the Trappist Monks at the Tre Fontane Convent have set out large plantations of the trees, and are tending them with the utmost care. This may fairly be look upon as a decisive experiment. The place known as the Tre Fontane—the Three Fountains—lies some miles south of Rome, and is the seat of a magnificent monastery. Yet its climate is so deadly that the splendid buildings, rich in mosaics, marbles, and frescoes are wholly deserted during the summer. Trying to live in them then would be certain death. If the blue-gum tree makes the Tre Fontane healthy, it can be relied on to do the same work anywhere else. Its record as an antiseptic and disinfectant is already a good one. The districts in which it is indigenous are healthy, and those into which it has been transplanted and in which it has thriven have become healthy. A few miles from the City of Algiers there was a farm which was noted for its deadly fevers. Life on it in July was almost impossible. In the spring of 1867, 1,300 eucalyptus trees were planted there. They were 9 feet high by the next July, and not a case of fever appeared since. Near Constantine, Algeria, there were vast swamps, never dry even in the hottest summers, and productive of violent periodic fevers. About 14,000 eucalyptus trees dried up every square foot of swamp and killed the fever. Maison Caree, near Hanash, was once a great market for quinine. The demand for that drug has ceased since the blue-gum tree was planted there. Mercantile books are said to show a similar decline in the amount of quinine consumed in Mexico and Cuba of late, and a similar cause is given for it. A very unhealthy railroad-station in the Department of Var, Southern France, has been made healthy by a grove of forty of these remarkable trees.

Their introduction into the Northwest would prevent a vast amount of fever-and-ague, if they would only grow. But unfortunately they would not. A slight frost or a succession of storms kills them. They would die here faster than the patients whose lives they are intended to save.

The Cause of Overflows in Louisiana.

To properly discuss this subject, some regard must be paid to the topography of the overflowed region.

The Delta below the mouth of the Arkansas, is an inclined plane towards the Gulf. It is also a valley, bounded on the east by the banks of the river, and on the west by the highlands in the interior of the State. All the water escaping from the river flows into this valley. That escaping below the mouth of the Arkansas has no chance of returning to the Mississippi, except at the mouth of Red River. If the flood which has escaped above, after slowly working its way through the densely timbered swamps, finds the Mississippi low at the mouth of Red River, a considerable portion of that flood will return to the Mississippi. If, on the contrary, the river be high, a much less quantity will be received by it, and the flood will sweep broadcast across the surface of Red River, deluging the intervening country towards the Gulf. This flood has generally, in cases of great overflows, been augmented by the occurrence of crevasses below the mouth of Red River. In the region thus overflowed, the highest formations of land are covered to a depth of three to five feet; the lower from twelve to fifteen feet. The land on which the cultivated plantations are situated, is from one to three feet above the ordinary high-water mark where the levees on the Mississippi have not given away.

In the year 1828, the levees between the mouth of the Arkansas and Red Rivers were incomplete. The water that had escaped from the Mississippi many weeks before, met the highest flood of that river at the mouth of Red River. Finding no adequate vent there, its course was continued to the gulf, submerging the region below.

In the years 1865, 1867, and 1874, owing to the destruction and neglect of the levees during the war, the same incidents occurred.

To fully appreciate the cause above assigned for the overflows, it is only necessary to refer to the happening of events that are frequently experienced.

If, on an ordinary mill stream, there be located mills at successive distances, should the first dam break it is likely to carry off the second, and so on until every dam is destroyed. In such cases a destructive flood is produced, which never could have occurred had not the water been interrupted in its flow by the various dams. So the breaking of the reservoirs of manufactories has caused destructive freshets, in consequence of the water having been artificially obstructed.

The same phenomenon occurs in reference to the great overflows of the Mississippi. The upper levees are the first to give way. They have generally done so several weeks before the river rose to its highest point. The waters discharged through those breaks, gradually fill up the immense swamp, and owing to the obstructions in their course, from the heavy forests, dense under-growth and cane-breaks, do not reach the mouth of Red River until about the time the Mississippi has attained its greatest height. Enough of this flood returns to the river to endanger the levees below, and the balance flows across Red River to the Gulf. The forests, with their dense under-growth, have acted as partial dams, which have retained the water, until it is precipitated below at the instant of greatest danger.

If the same waters had been kept in the channel of the river, they would harmlessly have long before reached the Gulf. Having been pent up by the impediments described, at the most unfortunate hour, they rush upon the country below with the impetus of water from broken mill-dams and reservoirs.

The channel of the river may be enlarged and overflows prevented, by the construction of a proper system of levees. Outlets can prove of no permanent advantage. The current of the Mississippi has sufficient energy to keep its channel open. This is evidenced by the fact that it frequently changes its channel making a new one without difficulty. If the body of water be greatly diminished, the force of the current will be lessened, and a sedimentary deposit must take place. The converse of this is equally true. If the quantity of water be increased, the

force of the current will also be increased, and its abrasive power augmented. Outlets diminish the force of the current, and cause a deposit of sediment; and the capacity of the channel to discharge the water is diminished. Instead of preventing inundations, the ultimate effect of outlets must be to raise the high-water mark, and consequently aggravate the evil.

Street Grades.

To the Honorable Committee on establishing Grades in the Additions to the City of Burlington:

GENTLEMEN—The subject of grades in a rough city like Burlington, is one that deserves particular attention, as the location of our streets is fixed and established without reference to the topographical features of the City, rendering it more difficult to determine easy and judicious gradients.

The least amount of draft, and the greatest speed is secured on a perfectly level road. But in connection with the grade of a road, the question of drainage is a very important one; in order to keep the surface of a road dry, an inclination becomes necessary; this is effected in two ways, and conjointly by both—a transverse and a longitudinal slope. The longitudinal slope must be sufficient to convey water, and with it the detritus consequent upon the wear of the street by travel and the washings of rain. For the purpose of drainage we find in practice the minimum slope to be 1:125, which is sufficient only to wash away fine dust. For coarser detritus a steeper grade is necessary. One gutter in this town, with a grade of 4:100, barely keeps itself clean, on account of the character of the material getting into it.

The minimum slope having been determined, and it being an impossibility to have all our grades as easy as this, the question is, what shall be the maximum slope? The maximum slope is dependent on two considerations, according as the slope is viewed, as a descent or as an ascent. The maximum ratio of descent chiefly concerns safety of speed, and in practice is the same as the angle of repose, which on the average of roads is about 3:100. The maximum slope, considered as an ascent, chiefly concerns the draft of heavy loads; this is a complicated question, and one of vital importance, as it is a question of public expense and economy; when the exact amount of traffic passing over a road can be arrived at, the grade will be determined by balancing the cost of making the grade against the interest of the value of the traffic; but to ascertain the amount of the traffic in most cases is impossible. The maximum slope is also governed by circumstances depending on the length of the grade and the character of the surface improvements. In practice the aim has been to make the maximum slope of ascent as low as that fixed when considered as a descent, being about 3:100, varying from 2½:100 to 5:100.

The following table will be useful in making comparisons of the proportional amount of traffic on different grades, the power expended being the same in each case.

The load on a level grade being assumed as unity.

The load on a grade of	2.25	:100	will be		¼
" " "	3	:100	"		⅓
" " "	4.15	:100	"		½
" " "	5.80	:100	"		⅔
" " "	10	:100	"		¾

One authority on maximum slopes fixes 7:100 as the extreme limit on which a horse can draw up a load (calculated for the minimum grade) by giving the horse his own gait and resting every few minutes. A grade of 6:100 is the exceptional maximum used in practice by many authorities. In a city where streets have been injudiciously located without reference to the topographical features, it may be false economy to attempt to reduce our grades to 6:100, and it may be expedient to use grades as steep as 10 or 12:100 where they are short. Yet the public welfare demands practical grades so far as possible; and we must fix our line of demarcation. I would recommend first, that on such streets as are to any extent favored by topography, the grades be made as easy as possible; second, that on such streets as are likely to become thoroughfares from their direction, or on which the lots front, the grades may be made as moderate as may be consistent with moderate cost; then let the grades on the remaining streets and cross streets be such as they will, to connect with the grades already determined, so long as they are barely practicable.

So far we have treated the grades on each street independently. We now have to treat of them in their intersections with one another, in which the subject of transverse slopes will have to be considered. Authors give two general constructions for independent streets; one in which each side of the street is of the same elevation and the centre crowning; the other occuring on a side hill in which the *hill side* is depressed. To preserve the level cross-section of streets it is necessary to make the longitudinal slope level through the rectangle of the street intersection. In the majority of instances in as rough a city as this, the level grade on the street intersection, although it is very desirable to maintain level cross-sections, is objectionable on account of making steeper grades between the cross-streets. The moment we abandon the level cross-section with a crowned centre, I would recommend a straight transverse plane, of sufficient inclination to secure good drainage; we must also determine the maximum transverse slope, which ought not to exceed the average angle of repose of 3:100, although our present poor surface improvements would admit a grade of 5-100; but we must design for better days and good work. As the sidewalks on each side of the street descend uniformly toward the centre, we find the length of the transverse slope confined between the two curbstone lines, or more properly between the gutters, making a length of 56 feet down to 18 feet, according to the width of our streets, making the total descent from one side of the street to the other only 1.7 feet to .5 feet. I find two feet fall to be a maximum limit among neighboring cities; yet we have instances in the old grades of the original City of Burlington of a fall of 10 feet in crossing a street, which in a width of 56 feet would be a ratio of 18:100, which would occasion continual sliding and danger of overturning. On a grade of 20:100 the labor of a horse in ascending is sufficient to draw an ordinary load on level ground.

When the grades are fixed and the elevations determined, I would recommend fixing the top of the curbstone as the grade height, each corner sidewalk square being level, and giving the level of each corner on every street intersection, as this will avoid all ambiguity, and there will never be a variance exceeding an inch or two among careful engineers in giving grades.

Respectfully submitted,

GEO. T. NEALLEY,
City Engineer.

IT is most important that a young Engineer should cultivate an earnestness of purpose and determination of character, for this will enable him to carry to a proper end, and to do well whatever he undertakes. How many important engineering matters have been brought to a point verging on a successful issue, and then, for want of a little energy and determination, recklessly abandoned! First ascertain that what you aim at is within your reach, and then let nothing interfere with the attainment of your object. There are few ends which a good engineer cannot compass, if he has time and money at his disposal. He should, however, above all things, do well what he undertakes; it is better to fail altogether, than that the work should be done in a slovenly manner.—*Hints to Engineers.*

There are are now completed and in operation 325 miles of the Texas and Pacific railroad, and it is confidently expected that during the present year 125 miles more will be constructed and put in operation. This gives direct connection from Shreveport to Texarkana, to Dallas, Sherman, and Fort Worth.